FIG. 1 PRIOR ART

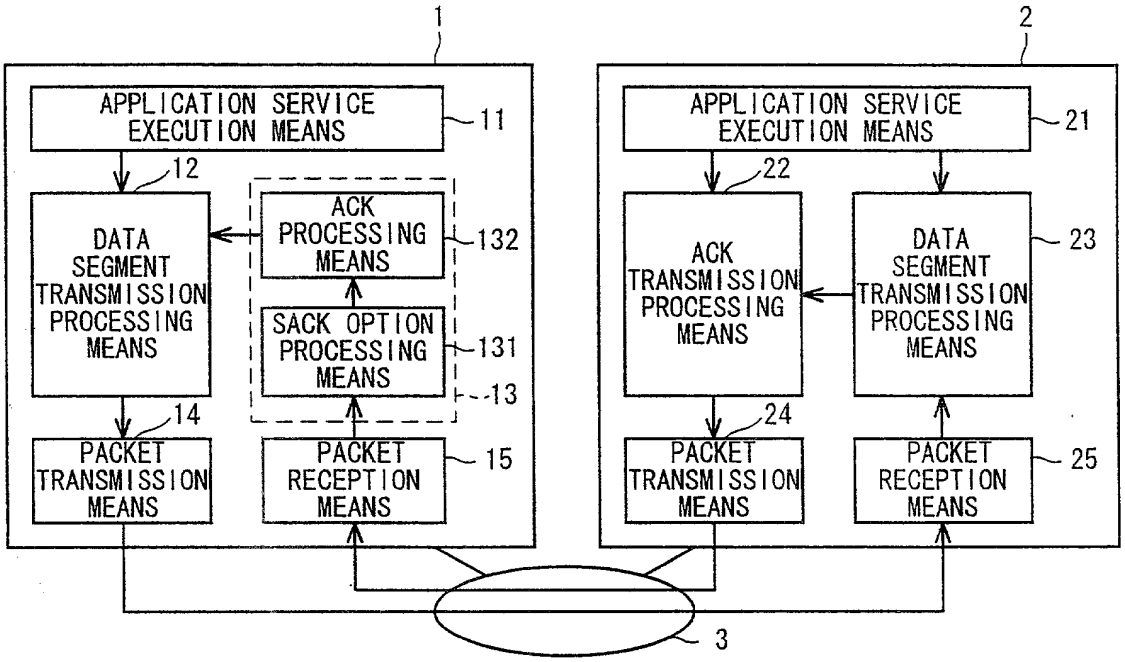


FIG. 2 PRIOR ART

SCORE BOARD

start	1001	→	start	5001	→	start	7001	→ ...
end	2000		end	6000		end	8000	
retran	1000		retran	4000		retran	6000	

FIG. 3 PRIOR ART

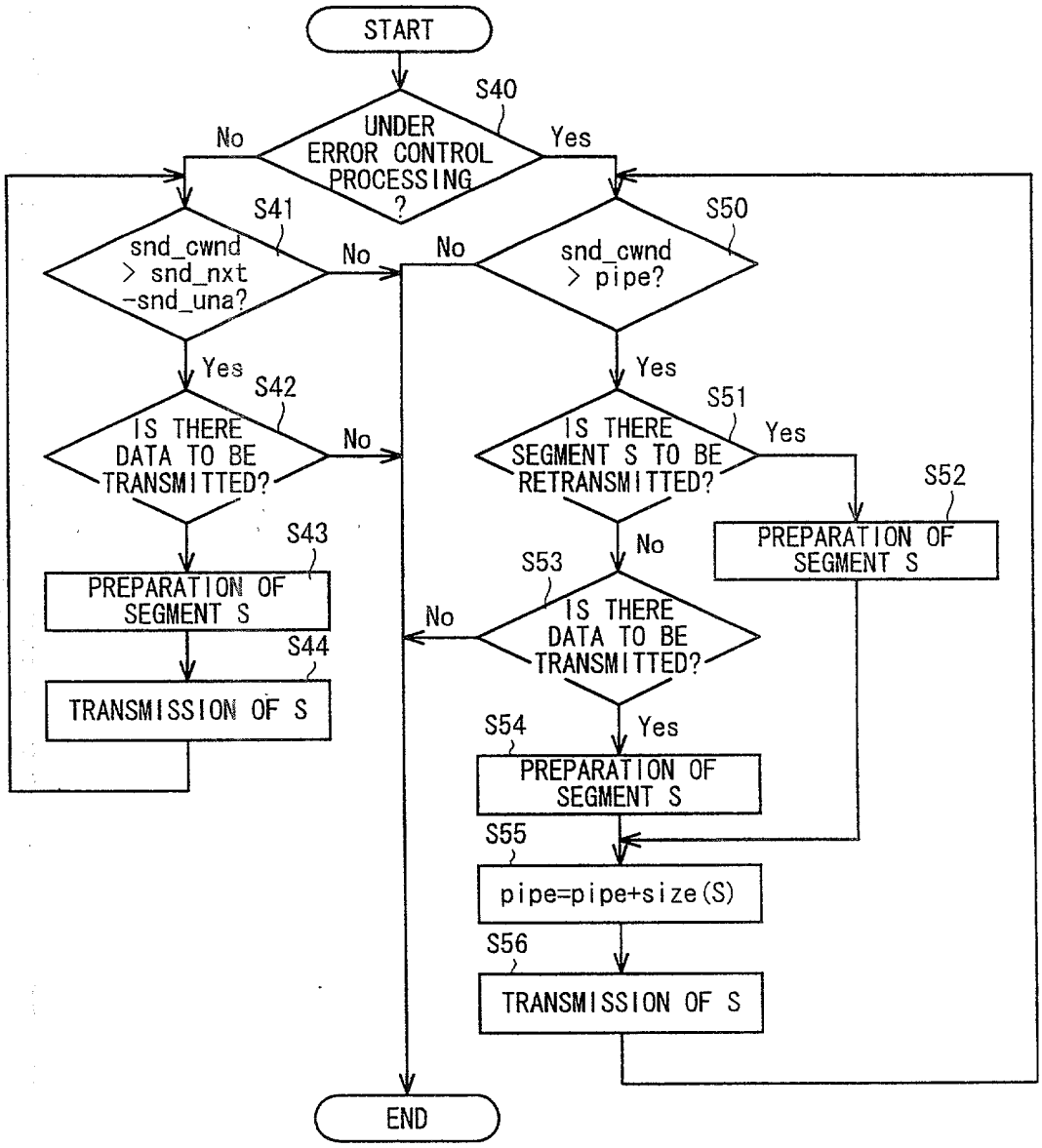


FIG. 4 PRIOR ART

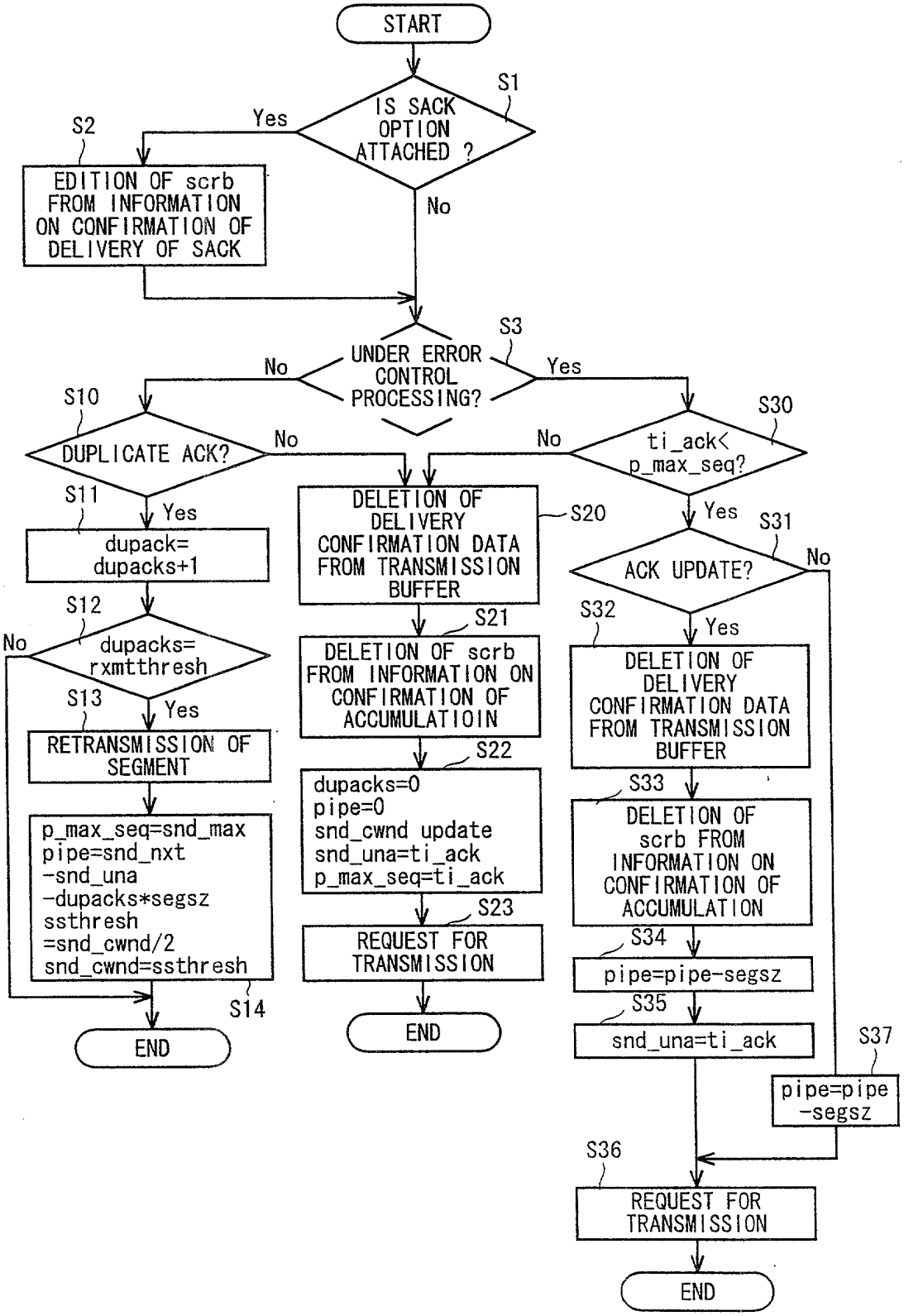


FIG. 5 PRIOR ART

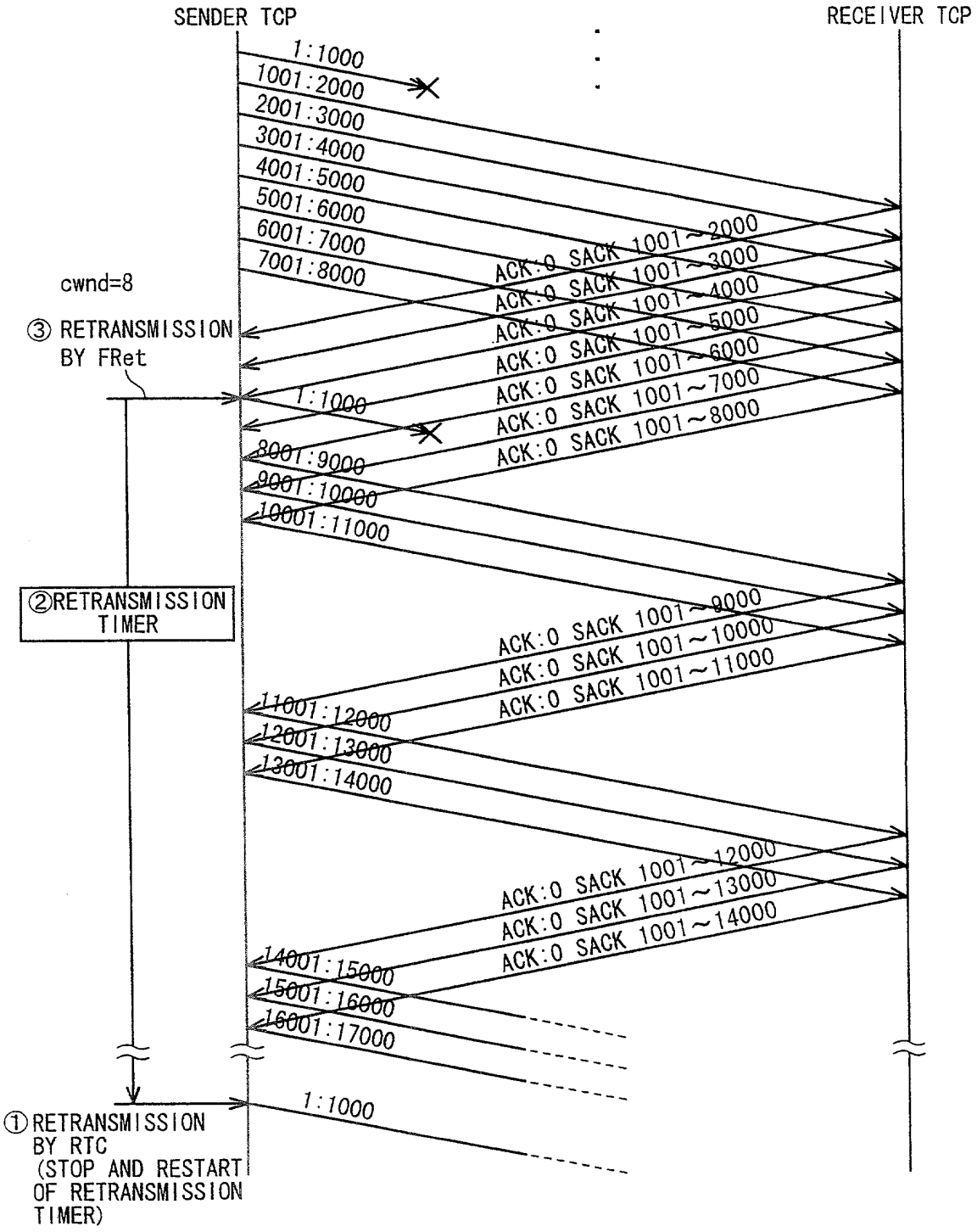


FIG. 6 PRIOR ART

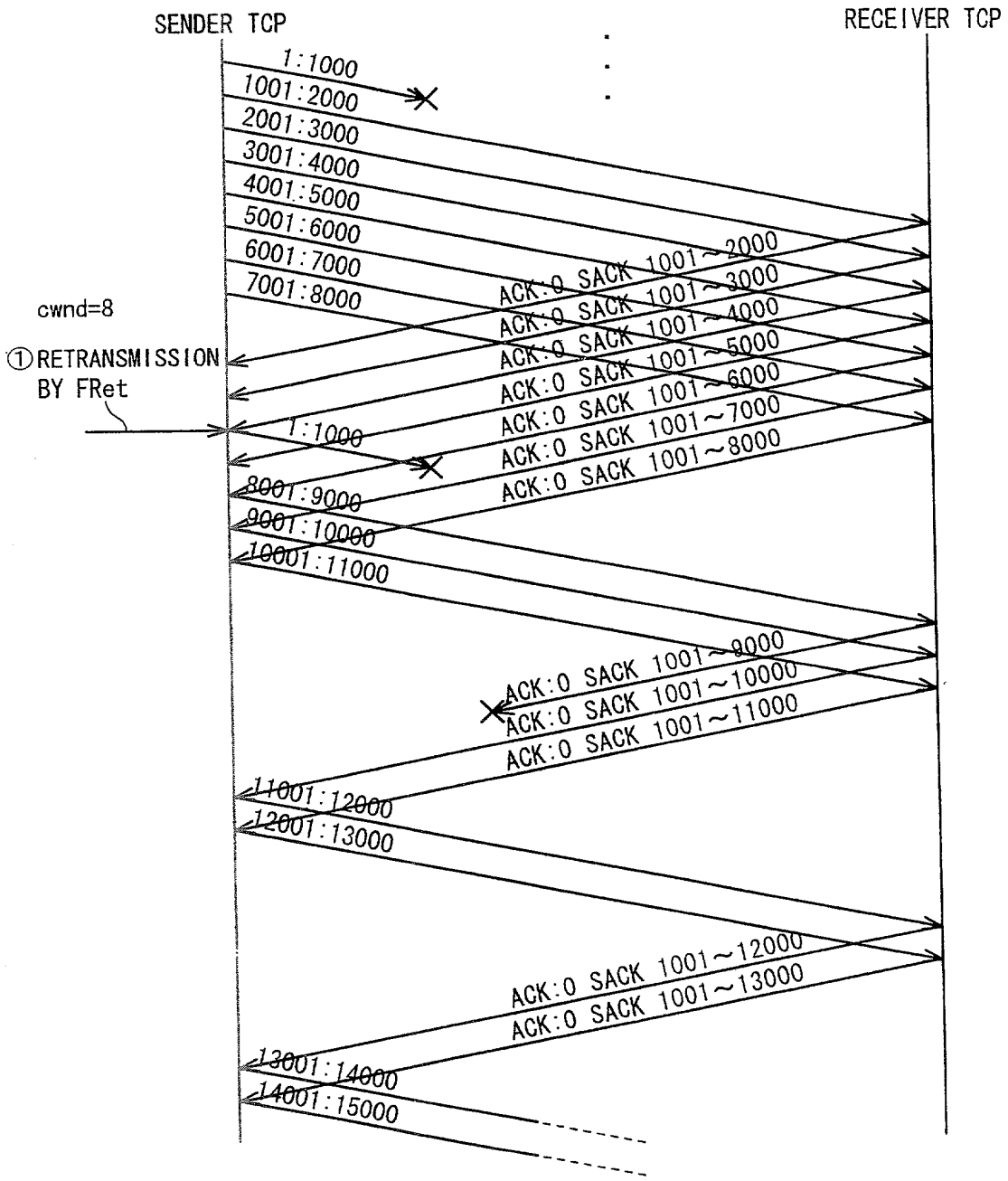


FIG. 7

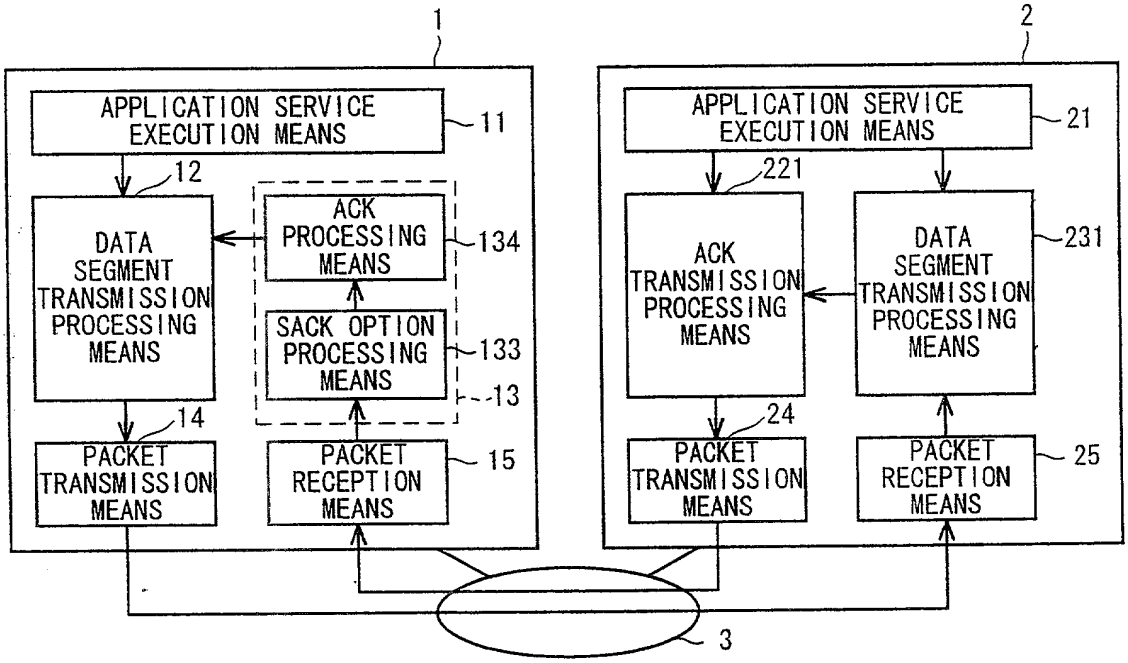


FIG. 8

ROUND TRIP COUNTER

RTC	2

TRANSMISSION SEGMENT LIST

start	1
end	1000
rt	1

→

start	1001
end	2000
rt	2

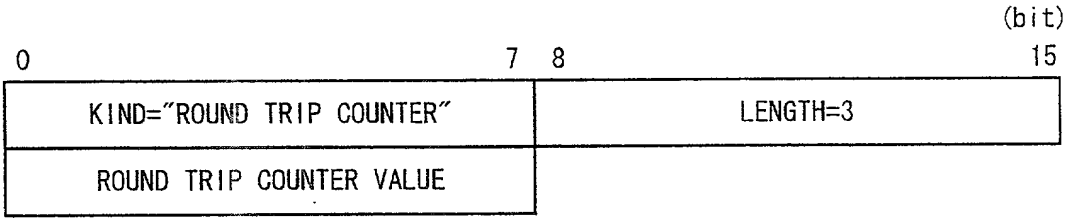
→

start	2001
end	3000
rt	2

→ . . .

FIG. 9

ROUND TRIP COUNTER OPTION



ROUND TRIP COUNTER ECHO OPTION

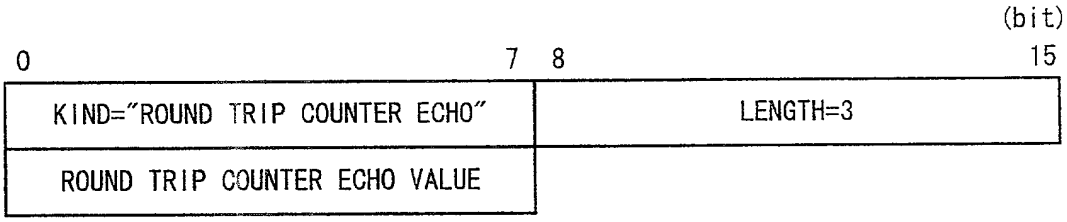


FIG. 10

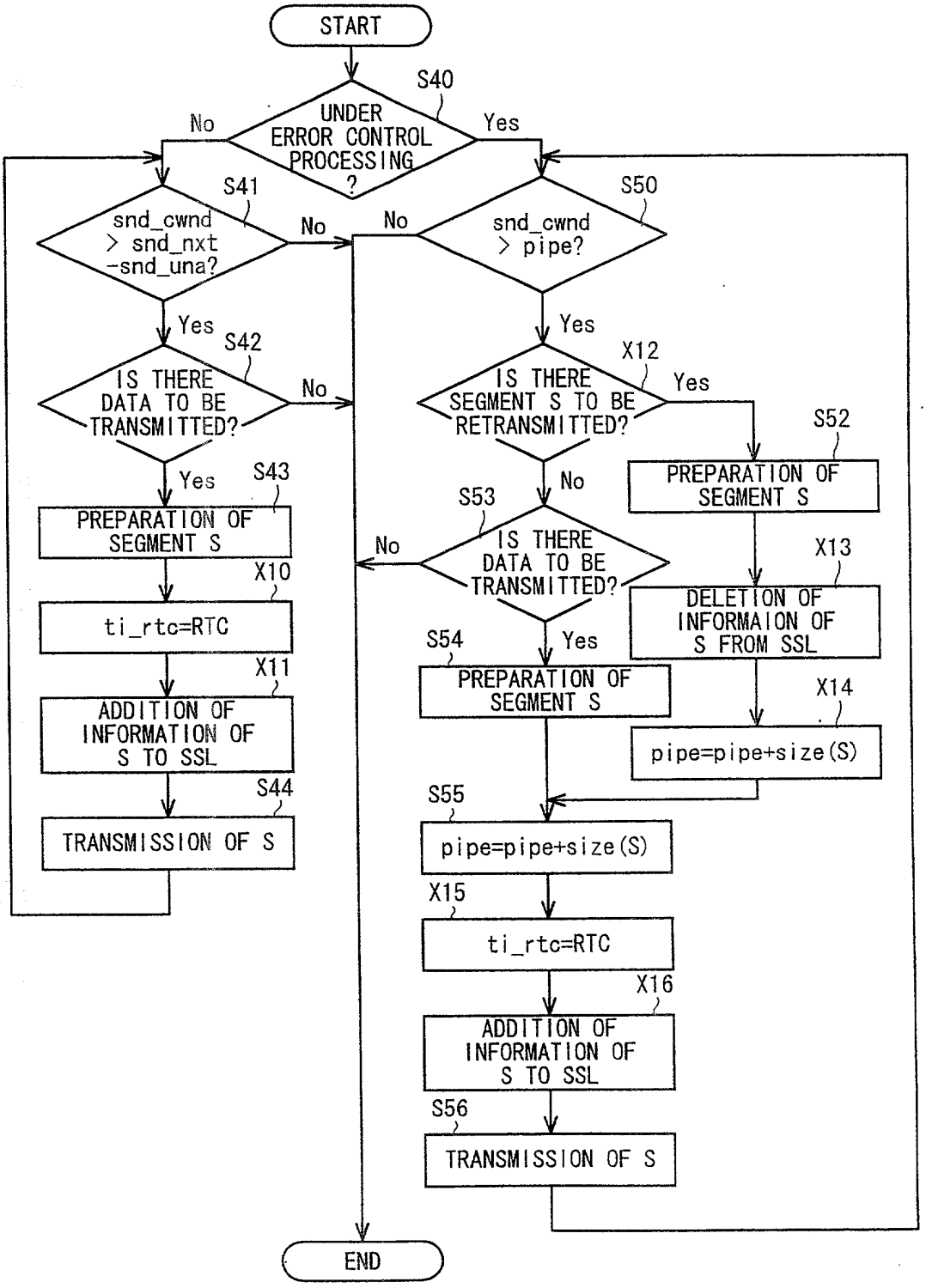

START
S40
UNDER ERROR CONTROL PROCESSING ?
No
Yes
S41
snd_cwnd > snd_nxt -snd_una?
No
Yes
S42
IS THERE DATA TO BE TRANSMITTED?
No
Yes
S43
PREPARATION OF SEGMENT S
X10
ti_rtc=RTC
X11
ADDITION OF INFORMATION OF S TO SSL
S44
TRANSMISSION OF S
S50
snd_cwnd > pipe?
No
Yes
X12
IS THERE SEGMENT S TO BE RETRANSMITTED?
Yes
No
S52
PREPARATION OF SEGMENT S
X13
DELETION OF INFORMAION OF S FROM SSL
X14
pipe=pipe+size(S)
S53
IS THERE DATA TO BE TRANSMITTED?
No
Yes
S54
PREPARATION OF SEGMENT S
S55
pipe=pipe+size(S)
X15
ti_rtc=RTC
X16
ADDITION OF INFORMATION OF S TO SSL
S56
TRANSMISSION OF S
END

FIG. 11

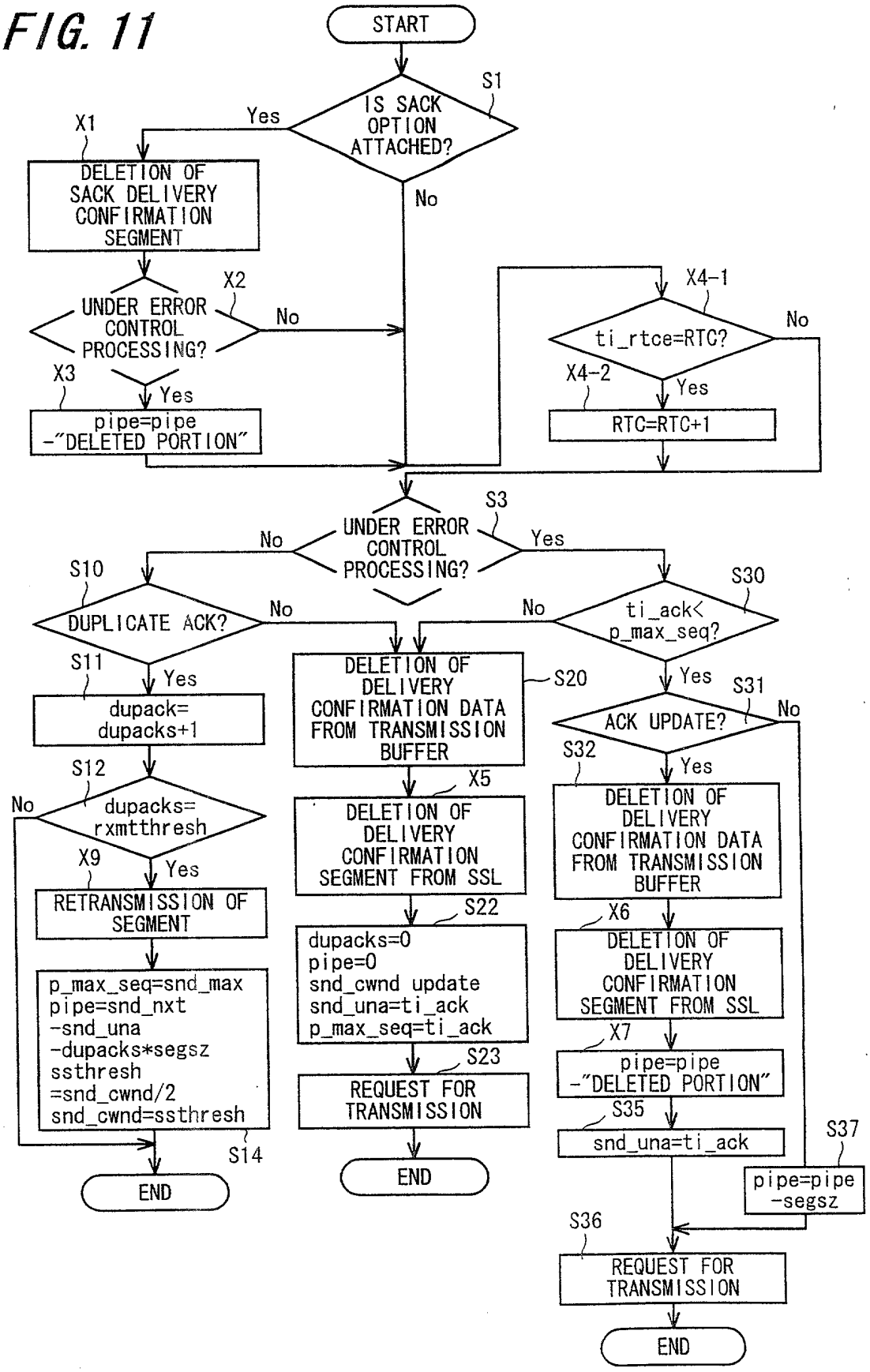

START
S1
IS SACK OPTION ATTACHED?
Yes
No
X1
DELETION OF SACK DELIVERY CONFIRMATION SEGMENT
X2
UNDER ERROR CONTROL PROCESSING?
No
X3
Yes
pipe=pipe -"DELETED PORTION"
X4-1
ti_rtce=RTC?
No
X4-2
Yes
RTC=RTC+1
S3
UNDER ERROR CONTROL PROCESSING?
No
Yes
S10
DUPLICATE ACK?
No
S11
Yes
dupack= dupacks+1
S12
dupacks= rxmtthresh
No
X9
Yes
RETRANSMISSION OF SEGMENT
p_max_seq=snd_max
pipe=snd_nxt
-snd_una
-dupacks*segsz
ssthresh
=snd_cwnd/2
snd_cwnd=ssthresh
S14
END
S20
DELETION OF DELIVERY CONFIRMATION DATA FROM TRANSMISSION BUFFER
X5
DELETION OF DELIVERY CONFIRMATION SEGMENT FROM SSL
S22
dupacks=0
pipe=0
snd_cwnd update
snd_una=ti_ack
p_max_seq=ti_ack
S23
REQUEST FOR TRANSMISSION
END
S30
ti_ack< p_max_seq?
No
Yes
S31
ACK UPDATE?
No
S32
Yes
DELETION OF DELIVERY CONFIRMATION DATA FROM TRANSMISSION BUFFER
X6
DELETION OF DELIVERY CONFIRMATION SEGMENT FROM SSL
X7
pipe=pipe -"DELETED PORTION"
S35
snd_una=ti_ack
S37
pipe=pipe -segsz
S36
REQUEST FOR TRANSMISSION
END

FIG. 12

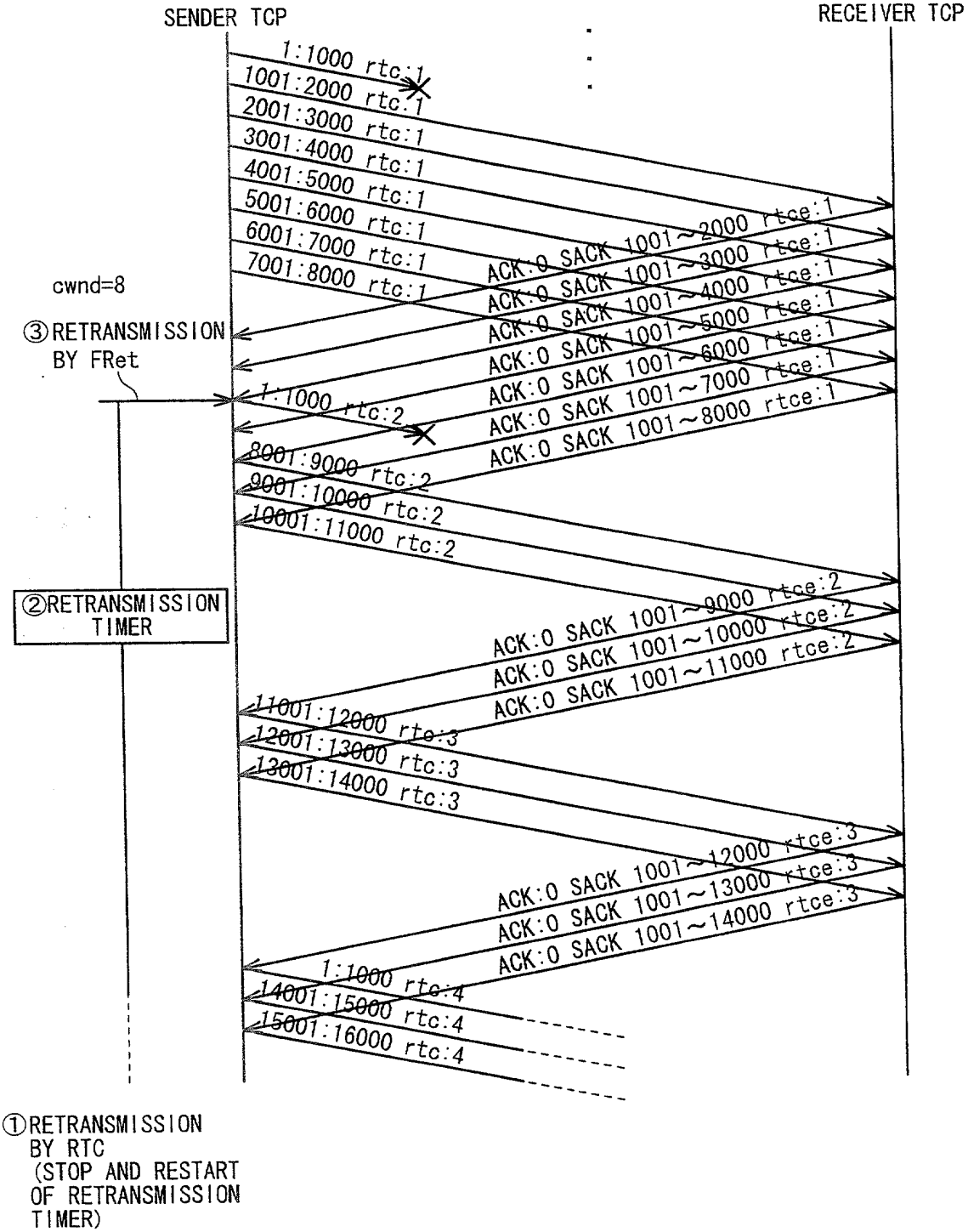

SENDER TCP
RECEIVER TCP
1:1000 rtc:1
1001:2000 rtc:1
2001:3000 rtc:1
3001:4000 rtc:1
4001:5000 rtc:1
5001:6000 rtc:1
6001:7000 rtc:1
7001:8000 rtc:1
ACK:0 SACK 1001~2000 rtce:1
ACK:0 SACK 1001~3000 rtce:1
ACK:0 SACK 1001~4000 rtce:1
ACK:0 SACK 1001~5000 rtce:1
ACK:0 SACK 1001~6000 rtce:1
ACK:0 SACK 1001~7000 rtce:1
ACK:0 SACK 1001~8000 rtce:1
cwnd=8
③RETRANSMISSION BY FRet
1:1000 rtc:2
8001:9000 rtc:2
9001:10000 rtc:2
10001:11000 rtc:2
②RETRANSMISSION TIMER
ACK:0 SACK 1001~9000 rtce:2
ACK:0 SACK 1001~10000 rtce:2
ACK:0 SACK 1001~11000 rtce:2
11001:12000 rtc:3
12001:13000 rtc:3
13001:14000 rtc:3
ACK:0 SACK 1001~12000 rtce:3
ACK:0 SACK 1001~13000 rtce:3
ACK:0 SACK 1001~14000 rtce:3
1:1000 rtc:4
14001:15000 rtc:4
15001:16000 rtc:4
①RETRANSMISSION BY RTC (STOP AND RESTART OF RETRANSMISSION TIMER)

FIG. 13

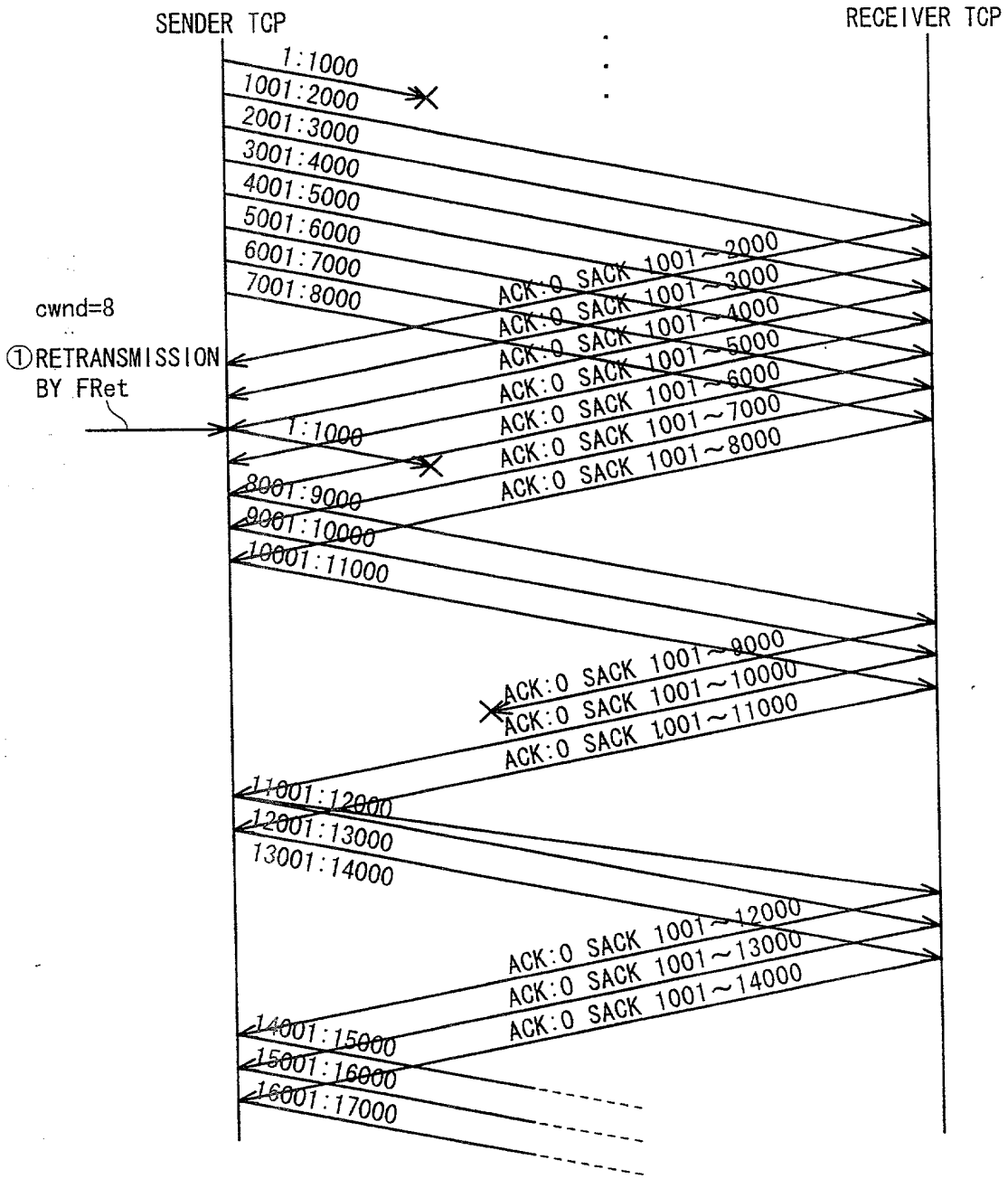

SENDER TCP
RECEIVER TCP
1:1000
1001:2000
2001:3000
3001:4000
4001:5000
5001:6000
6001:7000
7001:8000
ACK:0 SACK 1001~2000
ACK:0 SACK 1001~3000
ACK:0 SACK 1001~4000
ACK:0 SACK 1001~5000
ACK:0 SACK 1001~6000
ACK:0 SACK 1001~7000
ACK:0 SACK 1001~8000
cwnd=8
①RETRANSMISSION BY FRet
1:1000
8001:9000
9001:10000
10001:11000
ACK:0 SACK 1001~9000
ACK:0 SACK 1001~10000
ACK:0 SACK 1001~11000
11001:12000
12001:13000
13001:14000
ACK:0 SACK 1001~12000
ACK:0 SACK 1001~13000
ACK:0 SACK 1001~14000
14001:15000
15001:16000
16001:17000

FIG. 14

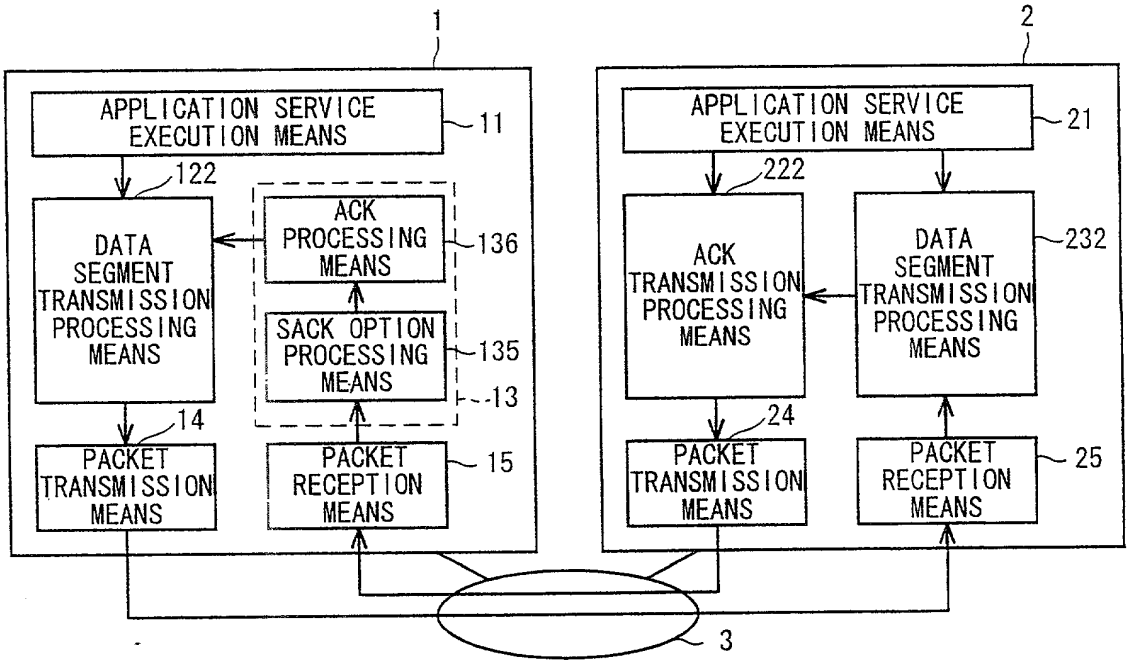


FIG. 15

ROUND TRIP COUNTER

RTC	2

ROUND TRIP TABLE

RTC	TIME
1	11111
2	11222
:	:

TRANSMISSION SEGMENT LIST

start	1
end	1000
TS	11111

→

start	1001
end	2000
TS	11222

→

start	2001
end	3000
TS	11333

→ . . .

FIG. 16

TIME STAMP OPTION

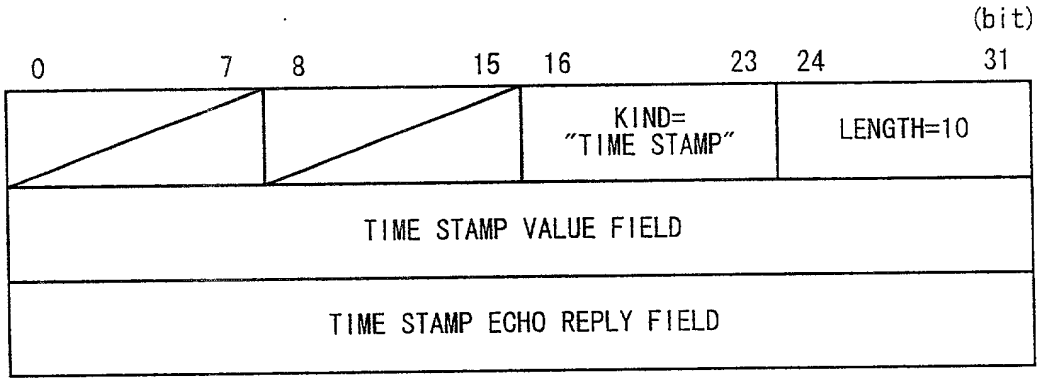


FIG. 17

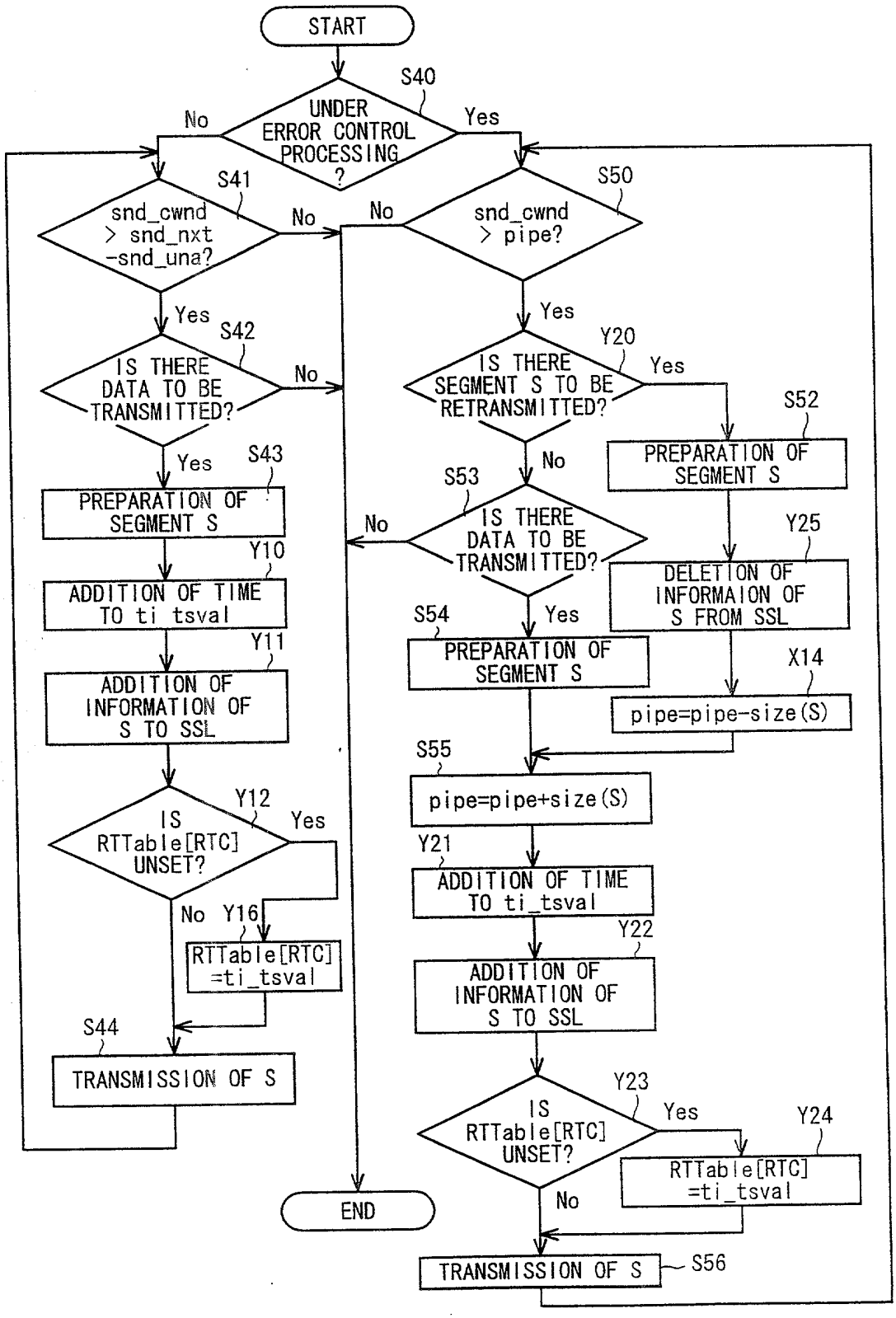
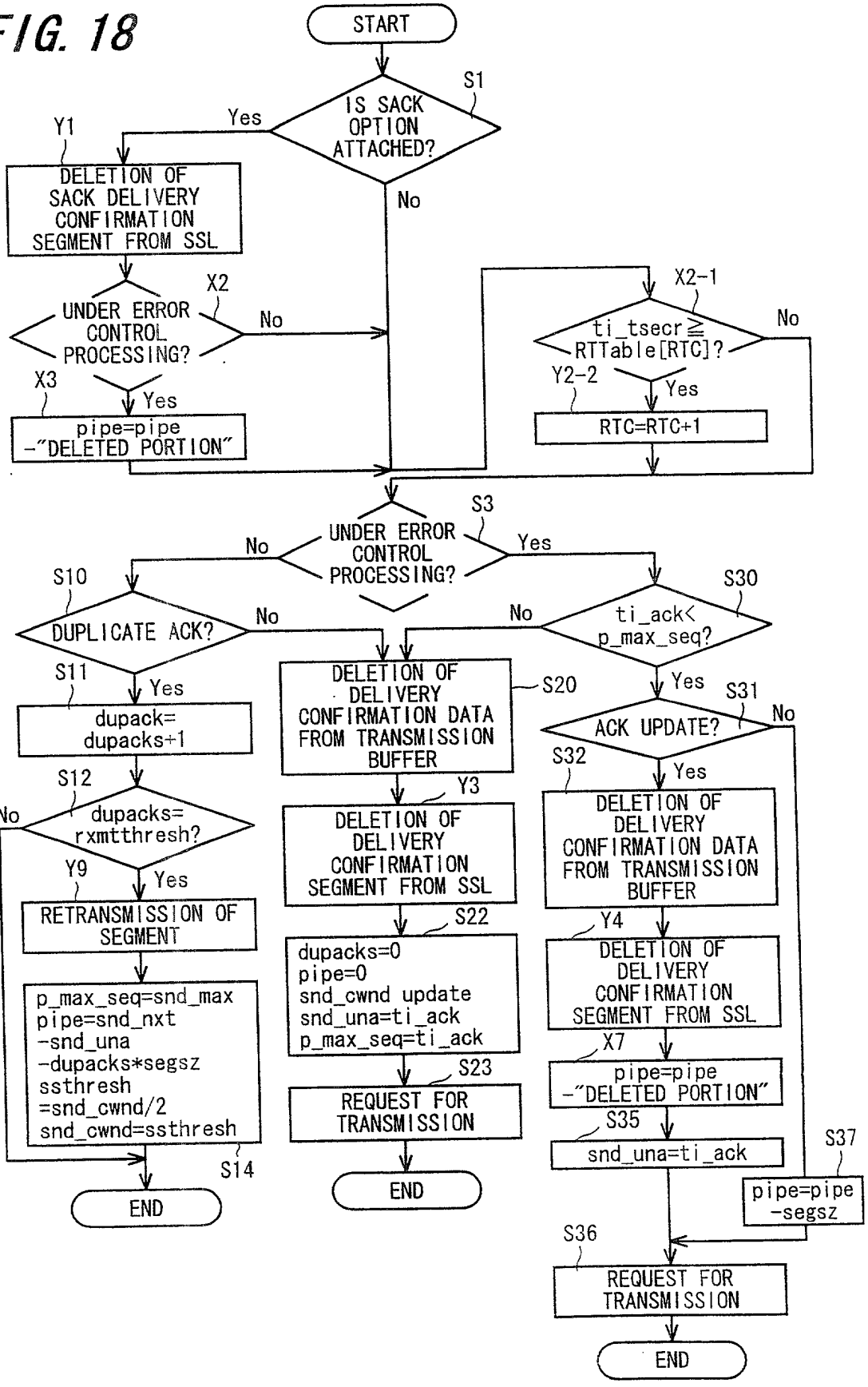

START
S40
UNDER ERROR CONTROL PROCESSING ?
No
Yes
S41
snd_cwnd > snd_nxt -snd_una?
No
Yes
S42
IS THERE DATA TO BE TRANSMITTED?
No
Yes
S43
PREPARATION OF SEGMENT S
Y10
ADDITION OF TIME TO ti tsval
Y11
ADDITION OF INFORMATION OF S TO SSL
Y12
IS RTTable[RTC] UNSET?
Yes
No
Y16
RTTable[RTC] =ti_tsval
S44
TRANSMISSION OF S
END
S50
snd_cwnd > pipe?
No
Yes
Y20
IS THERE SEGMENT S TO BE RETRANSMITTED?
Yes
No
S52
PREPARATION OF SEGMENT S
Y25
DELETION OF INFORMAION OF S FROM SSL
X14
pipe=pipe-size(S)
S53
IS THERE DATA TO BE TRANSMITTED?
No
Yes
S54
PREPARATION OF SEGMENT S
S55
pipe=pipe+size(S)
Y21
ADDITION OF TIME TO ti_tsval
Y22
ADDITION OF INFORMATION OF S TO SSL
Y23
IS RTTable[RTC] UNSET?
Yes
No
Y24
RTTable[RTC] =ti_tsval
TRANSMISSION OF S
S56

FIG. 18


START
S1
IS SACK OPTION ATTACHED?
Yes
No
Y1
DELETION OF SACK DELIVERY CONFIRMATION SEGMENT FROM SSL
X2
UNDER ERROR CONTROL PROCESSING?
No
X3
Yes
pipe=pipe -"DELETED PORTION"
X2-1
ti_tsecr≧ RTTable[RTC]?
No
Y2-2
Yes
RTC=RTC+1
S3
UNDER ERROR CONTROL PROCESSING?
No
Yes
S10
DUPLICATE ACK?
No
S11
Yes
dupack= dupacks+1
S12
dupacks= rxmtthresh?
No
Y9
Yes
RETRANSMISSION OF SEGMENT
p_max_seq=snd_max
pipe=snd_nxt -snd_una -dupacks*segsz
ssthresh =snd_cwnd/2
snd_cwnd=ssthresh
S14
END
DELETION OF DELIVERY CONFIRMATION DATA FROM TRANSMISSION BUFFER
S20
Y3
DELETION OF DELIVERY CONFIRMATION SEGMENT FROM SSL
S22
dupacks=0
pipe=0
snd_cwnd update
snd_una=ti_ack
p_max_seq=ti_ack
S23
REQUEST FOR TRANSMISSION
END
S30
ti_ack< p_max_seq?
No
Yes
S31
ACK UPDATE?
No
Yes
S32
DELETION OF DELIVERY CONFIRMATION DATA FROM TRANSMISSION BUFFER
Y4
DELETION OF DELIVERY CONFIRMATION SEGMENT FROM SSL
X7
pipe=pipe -"DELETED PORTION"
S35
snd_una=ti_ack
S37
pipe=pipe -segsz
S36
REQUEST FOR TRANSMISSION
END